

**WHAT IS CLAIMED IS:**

1        1. A method of designing a phase shift mask, the method  
2 comprising:

3                identifying edges of a first phase region of a phase shifting  
4 mask, the first phase region being located proximate a critical region and  
5 the identified edges not being edges of the first phase region adjacent to  
6 the critical region; and

7                defining a boundary phase region along the identified edges  
8 of the first phase region.

1        2. The method of claim 1, further comprising:

2                identifying edges of a second phase region of the phase  
3 shifting mask, the second phase region being located proximate the  
4 critical region and the identified edges not being edges of the second  
5 phase region adjacent to the critical region; and

6                defining a second boundary phase region along the identified  
7 edges of the second phase region.

1        3. The method of claim 2, further comprising:

2                establishing a boundary around the defined boundary phase  
3 region; and

4                assigning area outside of the established boundary to have  
5 phase zero.

1        4. The method of claim 2, further comprising generating a trim  
2 mask to remove undesired patterns between first and second phase  
3 regions.

1       5.     The method of claim 3, wherein the first phase region is  
2     assigned a phase angle of zero and the second phase angle is assigned a  
3     phase angle of 180.

1       6.     The method of claim 5, further comprising generating a trim  
2     mask to remove undesired patterns between phase 0 and phase 180  
3     regions.

1       7.     The method of claim 1, further comprising defining a  
2     boundary around ends of a second phase region, wherein the ends are not  
3     adjacent the critical region.

1       8.     The method of claim 1, further comprising defining break  
2     locations where phase transitions are most likely to occur.

1       9.     The method of claim 8, wherein the break locations have a  
2     width that permits patterning and inspection.

1       10.    A method of generating phase shifting patterns to improve  
2     the patterning of integrated circuit features needing sub-nominal  
3     dimensions, the method comprising:

4              defining critical areas;  
5              creating phase areas on either side of the critical areas;  
6              assigning opposite phase polarities to the phase areas on  
7     either side of the critical areas; and  
8              constructing a boundary phase region outside of at least one  
9     the edges of the phase areas.

1       11.    The method of claim 10, further comprising:  
2              defining break regions where phase transitions are likely to  
3     occur;

4                   correcting design rule violations; and  
5                   applying optical proximity and process corrections to phase  
6                   areas to allow proper pattern generation.

1                 12. The method of claim 10, further comprising generating a trim  
2                   mask to remove undesired patterns between phase areas outside of a  
3                   desired pattern.

1                 13. The method of claim 12, wherein the generating is done by  
2                   oversizing boundary and break regions.

1                 14. A method of enhancing clear field phase shift masks with  
2                   boundary regions around outside edges of phase 0 and phase 180  
3                   regions, the method comprising:

4                   assigning phase polarities to phase areas, the phase areas  
5                   including first phase areas and second phase areas;  
6                   defining edges of the assigned phase areas;  
7                   defining a first phase boundary region around the defined  
8                   edges of the first phase area; and  
9                   defining a second phase boundary region around at least a  
10                  portion of the defined edges of the second phase area.

1                 15. The method of claim 14, wherein defining edges of the  
2                   assigned phase areas includes defining break regions where phase  
3                   transitions occur and generating polygons including edges but excluding  
4                   break regions, wherein the polygons are merged with the assigned phase  
5                   areas.

1                 16. The method of claim 14, further comprising generating a trim  
2                   mask to remove undesired patterns between the first and second phase  
3                   areas.

1        17. The method of claim 16, wherein the trim mask does not  
2 cover all or any of the second phase boundary region around at least a  
3 portion of the second phase area.

1        18. The method of claim 16, wherein the generating is done by  
2 oversizing the boundary and break regions.

1        19. A mask configured for use in an integrated circuit  
2 manufacturing process, the mask comprising:  
3              a critical section defined by first edges of a phase zero region  
4 and first edges of a phase 180 region;  
5              a first boundary phase region located outside second edges  
6 of the phase 180 region, the second edges of the phase 180 region being  
7 different than the first edges of the phase 180 region, wherein the first  
8 boundary phase region includes an opaque material; and  
9              a second boundary phase region around at least a portion of  
10 second edges of the phase 0 region, the second edges of the phase 0  
11 region being different than the first edges of the phase 0 region.

1        20. The mask of claim 19, further comprising a region outside of  
2 defined areas having a phase of zero.

1        21. The mask of claim 19, wherein the second boundary phase  
2 region includes an opaque material.